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| Please use this form to clearly and concisely report on project progress. The information included should reflect quantifiable results that can be used to evaluate and measure project success. Comments should be limited to the designated boxes. Technical reports, no longer than 4 pages, may be attached to this summary report. | |
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| Project Title: | Southern Root-Knot Nematode in Maturity Group 4 Soybean: Characterization of Resistance Mechanisms and Breeding for Resistance |
| Organization: | University of Arkansas System, Div of Ag |
| Principal Investigator Name: | Travis Faske |
| Report Period: | 3/15/2024 to 6/15/2024 |
| Project Status: | |
| **Objective 1. Characterization of the mechanism of resistance to SRKN. (Faske and Watson; Univ of Arkansas and LSU, respectively)**  A greenhouse experiment was designed to evaluate the reproduction vs galling in the PI lines that are being evaluated for the MOR to SRKN in this study at the Lonoke Extension Center in Arkansas. Based on the percentage of root system galled, all resistant lines (Forrest, PI 438489B, PI 567305, and PI 567516C) had lower (P = 0.05) than the susceptible control, Magellan. However, no single resistant cultivar had lower SRKN reproduction than Magellan. These data support that genes that control nematode reproduction are not necessary the same that control galling. Furthermore these data support the direction of this project to evaluate resistant germplasm that has both low reproduction and galling. This experiment was only conducted once and is in the process of being repeated at the Lonoke Extension Center.  **Objective 2: Genetic characterization and development of functional markers for new sources of resistance to SRKN. (Nguyen, Univ. of Missouri)**  Marker-Assisted Selection: Received 80 lines from Dr. Feng Lin's group (Fisher Delta Research Center, Portageville, MO) for screening for SRKN resistance. DNAs were extracted from the leaf samples of these 80 lines and were screened to identify major SRKN-resistant loci on Chromosome 10 using KASP PCR. Among all the soybean breeding lines, an elite line S21-22067 was found to be resistant to SRKN. This elite line is a promising resource that can be integrated into the breeding program for SRKN resistance.  Identification of RILs for Chr. 10 & Chr. 13 QTLs – Continuing the previous year's study, we identified about 32 RILs developed from a cross of Mag × PI 438489B based on major resistance on Chro. 10 and minor resistant on Chr. 13. These contrasting RILs were selected with a combination of QTL on Chr.10 + Chr. 13, only Chr.13 QTL, only Chr. 10 QTL, and further these RIL lines along with the parents were planted in the BREC field of the University of Missouri.  Seed increase: We planted seeds of the major RKN lines such PI 438489B, PI 567305, Forrest, PI 567516C, Magellan, and NILs at the University of Missouri & Arkansas for seed increase.  **Objective 3. Development of breeding populations and MG IV soybean varieties with resistance to SRKN.**  **University of Arkansas, Caio Vieira**: All field trials have been planted across testing locations in Arkansas including Stuttgart, Marianna, Pine Tree, and Rohwer. Crossing block and increases have been planted in Fayetteville, and progeny rows are scheduled to be planted this week. Samples for all preliminary stage entries have been processed for molecular marker analysis and results are expected in the next two weeks.  **2025 Potential Release:** Line R19-45980 was evaluated in the 2023 USDA Uniform Preliminary MG 5 (placing 3/37) and the Arkansas Variety Testing (100.5% of the test mean). In preparation for commercial release, pre-foundation seed is being grown in Stuttgart, Arkansas.  **2024 Population Development and Generation Advancement**: Seventy-four cross-combinations with at least one parental line carrying resistance to SRKN were performed during the crossing block in the summer of 2023. Generation advancement is ongoing smoothly in off-season nurseries. A total of 16,000 progeny rows will be grown in Kibler, AR in 2024. These will be evaluated based on uniformity and agronomic traits and pending selection, will move to 2025 preliminary yield trials. In 2024 crossing block, 16 parental lines with SRKN resistance will be used to develop between 70 and 90 high-yielding bi-parental populations combining SRKN resistance and multiple abiotic and biotic stressors.  **Identifying new sources of resistance:** As previously reported, 36 genetically diverse accessions between MGs 1 and 4 were identified from the USDA Germplasm Collection to be resistant to SRKN. These are being increased in Stuttgart, Arkansas and screened by the Pathologists in the group. Once resistance is confirmed, they will be used to develop new SRKN-resistant populations.   |  |  |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | --- | --- | | **University of Missouri, Feng Lin:**  Releases: A root-knot-resistant line S19-10701, conventional was released in 2024. This line has shown excellent yield potential in the absence of off-target Dicamba injury. It is an indeterminate mid-group IV [relative maturity (RM) 4.5] cultivar. It was tested across six states (AR, KS, MO, MS, TN, VA) in 32 environments, it yielded 94.1 to 113.8% of the non-Xtend check mean and 77 to 107.9% of the Xtend check mean, it averaged 19.4% oil, and 34.9% protein at 13% moisture. Seeds of S19-10701 have been submitted to the Missouri Foundation seed program for production. This line is also in winter nursery in the process of conversion to XtendFlex technology.  Promising lines in the regional test: In total, we sent for RKN phenotype screening 25 lines present in the USDA Southern Regional Testes. From these, 3 promising lines, maturity group 4, carry the RKN gene of Resistance to Root-Knot nematode. These lines are listed in the table below.  **Table 1:** Advanced lines in the Southern Regional Testes – USDA for yield test.   |  |  | | --- | --- | | Line | MG | | S21-11972HP | 4-L | | S21-17588LL55 | 4-M | | S21-22067 | 4-E |   AYT Lines: In 2024, a total of 100 lines are in Advanced yield trials (AYT). These lines were submitted for phenotypic screening, to be performed during the growing season. These lines were also analyzed using the CORTEVA panel and University of Missouri molecular markers. Out of the 100 lines, 34 showed the presence of the RKN resistance gene on chromosome 10 (more than 30%).  Progeny Rows: We have about 100 bi-parental populations derived from nematode-resistant pedigrees. These lines will be planted in the next weeks, according to the weather conditions, in Portageville and compared to widely grown commercial XtendFlex checks. These lines will be evaluated based on yield potential and other agronomic traits.  Breeding population advancement: In 2023, Two crosses were made with G11-7013 (elite line with a gene from PI96354) x University of Missouri RKN resistant lines. These crosses are listed in the table below. In addition, another 80 crosses were made using at least one source of Resistance to Nematode. These crosses will return in 2025 as progeny rows.. | | |